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Inventors: Nelson A. Blish, Sujatha Ramanujan and Joshua M. Cobb

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**A METHOD AND APPARATUS FOR CREATING A  
PRESELECTED LENTICULAR IMAGE**

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**A METHOD AND APPARATUS FOR CREATING A PRESELECTED  
LENTICULAR IMAGE**

**FIELD OF THE INVENTION**

The present invention relates to cameras in general and more  
5 particularly to an electronic camera which produces a preselected lenticular  
image.

**BACKGROUND OF THE INVENTION**

Lenticular overlays give images the appearance of depth or motion.  
A lenticular image is created using a transparent upper layer having narrow,  
10 parallel lenticules or semi-cylindrical lenses on an outer surface, and an image-  
containing substrate which projects images through the lenticules. The two layers  
form a lenticular system wherein different portions of an image are selectively  
visible as a function of the angle from which the system is viewed. If the image is  
a composite picture made by bringing together into a single image a number of  
15 different photographs of a scene photographed from different angles, and the  
lenticules are vertically oriented, each eye of a view will see different elements  
and the viewer will interpret the net results as depth of field. The viewer may also  
move his head with respect to the image thereby observing other views with each  
eye and enhancing the sense of depth. When the lenticules are oriented  
20 horizontally, each eye receives the same image. In this case, the multiple images  
give illusion of motion when the composite image is rotated about a line parallel  
to a line formed by the viewers eyes.

Whether the lenticules are oriented vertical or parallel, each of the  
viewed images are generated by lines of images which have been interlaced at the  
25 frequency of the lenticular or line blocking screen. Interlacing lines of each image  
is referred to as interdigitation. Interdigitation can be better understood by using  
an example four images used to form a composite with a material having three  
lenticules. In this example, line 1 from each of the four images is in registration  
with the first lenticule; line 2 from each of the four images is in registration with  
30 the second lenticule; etc. Each lenticule is associated with a plurality of image  
lines or an image line set, and the viewer sees only one image line of each set with  
each eye for each lenticule. It is imperative that the line image sets be registered

accurately with respect to the lenticules, so that a proper picture is formed when the assembly is viewed.

Lenticular images 60, as shown in Figure 1, are currently created by selecting several digital photographs, or digitizing photographic prints, and combining the individual photographs. In this example, a composite image comprised of eight photographs is scanned onto recording medium 62 by an eight-sided polygon 31. Facet 71 of polygon 70 lays down scanline 81 relating to a first original image. Facet 72 lays down scanline 82 from a second original image. This process is repeated with each facet laying down one line from each of the eight individual images until medium 60 has been advanced the width of one lenticule 64. The process is repeated with facet 71 laying down a second line from the first image as scanline 91, facet 72 laying down a second line of a second original image as scanline 92, and so forth until the media 62 has been advanced the width of another lenticule 64. Thus, each original image is laid down by only one facet of polygon 31.

Using this method, or other similar methods, the photographs have already been taken and individual photographs selected and digitized to prepare a lenticular image. One such system is shown in U.S. Patent No. 5,995,132. This is a retrospective process and is highly sensitive to laying down each line of each image, interlaced, in exact registration with each lenticule. Consumers who choose to have a lenticular image prepared may not know until the lenticular image is actually produced whether the results will be satisfactory. Since the lenticular print will not be ready until a period of time after the event has taken place, if the final results are unsatisfactory, the opportunity to retake the lenticular image will have passed.

There is a need for a prospective process, which will be more consumer friendly, increase the use of lenticular images, and result in lenticular prints which capture the depth images or motion images that the photographer intended.

## SUMMARY OF THE INVENTION

In one embodiment of the invention, a consumer selects a lenticular image mode on a digital camera. The digital camera electronically arranges a

charged couple device (CCD) sensor array into groups of three columns each. A first photograph is imaged on a first column of each group, a second photograph is imaged on a second column of each group, and a third photograph is imaged on a third column of each group. A complete, interleaved lenticular image is stored on a memory card.

An advantage of the present invention is that consumers will be able to select in advance which photographs are going to be lenticular, so that the digital images are preselected and preformatted when they are processed. An additional advantage of the present invention is that consumers will be able to preview preselected lenticular images when their camera is equipped with a lenticular liquid crystal display (LCD) screen. Preselected lenticular images will result in an increase in print orders for lenticular images and an increase in sales of digital cameras having this feature.

The above objects, advantages, and novel features of the present invention will become more apparent from the accompanying detailed description thereof when considered in conjunction with the follow drawings.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a schematic perspective view of a prior art polygon printer for printing interdigitated images from eight separate original images.

Figure 2 is a block diagram of the electronic components of a digital camera incorporating a charged coupled device (CCD) according to the present invention.

Figure 3 is a block diagram of the electronic components of a digital camera incorporating a complementary metal oxide semiconductor (CMOS) image sensor according to the present invention.

Figure 4 is a perspective view of a digital camera according to the present invention.

Figure 5 is a perspective view of a photographer taking a three dimensional (3D) preselected lenticular image according to the present invention.

Figure 6 is a perspective view of a photographer taking an action preselected lenticular image according to the present invention.

#### **DETAILED DESCRIPTION OF THE INVENTION**

The present invention will be directed in particular to elements forming part of, or in cooperation more directly with, the apparatus in accordance with the present invention. It is to be understood that elements not specifically shown or described may take various forms well known to those skilled in the art.

5 Referring now to Figure 2, a block diagram shows the electrical components of a digital camera 10 according to the present invention. A charged couple device (CCD) 11 is comprised of sensors 12 which are pixilated metal oxide semiconductors. Sensors 12 accumulate signal charge in each pixel proportional to the local illumination intensity, serving a spatial sampling  
10 function.

In the embodiment shown, simplified for the purpose of illustration, the CCD 11 is electronically divided into a first group 20 and a second group 30. Each of the groups are further subdivided into columns 21, 22, 23, and 31, 32, 33. When a mode selector 102 on the digital camera, shown in Figure 4, is  
15 used to select a lenticular image, the first photograph taken will only be recorded on a first column of each group. Thus, in the embodiment shown, the first image will be recorded on columns 21 and 31.

When an exposure is complete, each individual image sensor in the first column 21, converts photons to electrons. Each pixel's charge packet is  
20 sequentially transferred to a common output structure 40 and the electrons are converted to a voltage 42. In a similar fashion the first image will be recorded on the first column 31 of group 30 and the charge transferred.

A second image taken by digital camera 10 will be captured on a second column 22 of first group 20 and a second column 32 of second group 30.  
25 A third image is captured in a similar fashion on the third columns 23 of first group 20, and third column 33 second group 30. The three images are stored in an interleaved digital file on a memory card 52 ready for printing to the image side of a lenticular recording medium.

A printed circuit board 44 associated with the CCD 11 typically  
30 contains bias generation 45, clock and timing generation 46, clock drivers 47, gain 48, analog to digital conversion 49, frame grabber 50, and oscillator 51 for proper

operation of the charged coupled device 11. These components and their functions are well known in the art.

In a digital camera incorporating a complimentary metal oxide semiconductor (CMOS) imager 13, shown in Figure 3, the charge-to-voltage  
5 conversion takes place in each pixel 12. There is a difference in readout techniques for a CMOS imager, which has significant implications for sensor architecture, capabilities and limitations. Overall operation of a digital camera using a CMOS imager, however, will be similar to the embodiment described in detail above. The sensors 12 of the CMOS imager 13 are divided into a first  
10 group 20 and a second group 30 each of which is comprised of individual columns for the purpose of taking interleaved images for a preselected lenticular image as described above.

Figure 4 shows a perspective view of a digital camera 10 according to the present invention. A mode selector 102 has a 3D lenticular image position  
15 104 that is used by the operator for configuring the camera to capture a preselected 3D lenticular image which will give the appearance of depth. When a 3D preselected lenticular image is selected on the mode selector 102 the camera functions as described above. A standard position 108 on mode selector 102 is used to take a standard, single frame digital images.

To capture a 3D preselected lenticular image the camera operator  
20 takes a first photograph at a first position 121, as shown in Figure 5. A second photograph is taken at a second position 122, and a third photograph at a third position 123. The images are interleaved electronically to form a preselected lenticular image.

Referring to Figures 4 and 6, to take an action preselected  
25 lenticular image the camera operator 125 selects the appropriate action setting 106 on the mode selector 102 and depresses the camera shutter 110. The digital camera captures a series of images in a rapid fashion as the subject 127 moves. For example, some digital cameras today capture digital images in a burst mode at  
30 two frames per second (FPS). The images are processed electronically as described above and stored in an interleaved fashion.

In a further embodiment of the present invention burst mode switch 109 is set at a burst mode speed required by the action to be captured. For example, some sports events may require a higher burst mode speed, i.e., a batter swinging a bat in baseball. For other sports a slower speed may be appropriate, for example, a bowler making an approach shot prior to ball release. In the example shown the burst mode switch 109 has two settings, two frames per second and four frames per second, but a variety of other burst mode speeds may be appropriate.

In another embodiment of the invention a liquid crystal device (LCD) screen 112 on the back of the digital camera 10 contains a lenticular surface. See Figure 4. This allows viewing of the preselected lenticular image by the operator immediately after completing the series of photos used for the preselected lenticular image. In the example given above wherein a 3D image is created, the preselected lenticular image is presented to the viewer with lenticules 64 oriented vertically. The photographer views the preselected lenticular image from the angle 114, which is accomplished by turning the digital camera so that the LCD screen 112 is oriented vertically.

When an action preselected lenticular image is created the preselected lenticular image is displayed so that the lenticules are oriented horizontally with respect to the viewer. To view the action preselected lenticular image the viewer would orient the camera so that the lenticules 64 are parallel to the viewers eyes. The camera is tilted up and down to provide motion for the action preselected lenticular image.

It will be understood that the embodiments shown are simplified for purposes of illustration. A typical CCD or CMOS sensor for use in the present invention should be at least three mega-pixels in capacity to produce preselected lenticular images. This will produce sub-images of at least one mega-pixel each, lower resolution images, however, may be acceptable in some applications.

In the embodiments described the preselected lenticular image are comprised of only three separate sub-images corresponding to the three columns in each group. The CCD or CMOS sensors, however, can be subdivided electronically into groups having a plurality of columns, which correspond to the

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The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the scope of the invention.



**PARTS LIST**

10. Digital camera
11. Charged Coupled Device (CCD)
12. CCD sensors
13. CMOS imager
20. First group
21. Columns 1
22. Columns 2
23. Columns 3
30. Second group
31. Column 1
32. Column 2
33. Column 3
40. Output structure
42. Electron -to- voltage
44. Circuit board
45. Bias generation
46. Clock and timing generation
47. Clock drivers
48. Gain
49. Digital conversion
50. Frame grabber
51. Oscillator
52. Memory card
60. Lenticular images
62. Recording medium
64. Lenticules
70. Eight-sided polygon
71. Facet
72. Facet
- 81-88. Scanline
- 91-98. Scanline

10-11-12-13-20-21-22-23-30-31-32-33-40-42-44-45-46-47-48-49-50-51-52-60-62-64-70-71-72-81-88-91-98

- |      |                   |
|------|-------------------|
| 102. | Mode selector     |
| 104. | 3D position       |
| 106. | Action position   |
| 108. | Standard position |
| 109. | Burst mode switch |
| 110. | Camera shutter    |
| 112. | LCD screen        |
| 121. | First position    |
| 122. | Second position   |
| 123. | Third position    |
| 125. | Camera operator   |
| 127. | Subject           |